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EFFECTS OF TASK LOAD TASK SPEED AND COGNITIVE
COMPLEXITY ON SATISFACTION(U) MILTON S HERSHEY MEDICAL
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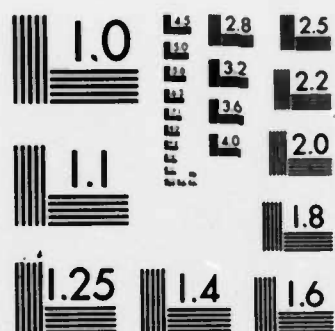
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more vs. less cognitively complex individuals. In general, increasing task difficulty (as manipulated and perceived) resulted in decreasing satisfaction with task performance. Enjoyment of the task decreased with increasing load but increased marginally with increasing task speed. It appears that satisfaction and enjoyment are two quite distinct phenomena. While cognitive complexity has no effect on satisfaction at high load levels, it does distinguish among persons' enjoyment of a task presented under high load conditions.



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Effects of Task Load, Task Speed
and Cognitive Complexity on Satisfaction

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The components, measurement, and application of "satisfaction" has been of interest to many organizational psychologists and other scientists. Considerable research on the topic has been completed. However, reviews of the area have shown that our understanding of the conditions which produce satisfaction or dissatisfaction is yet quite limited (e.g., Brayfield and Crockett, 1955; Bruggemann, Groskurth and Ulich, 1975; Fournet, Distefano and Pryer, 1966; Hertzberg, Mausner, Peterson and Capwell, 1957; Hoppock, 1935; James and Jones, 1980; King, 1970; Locke, 1976; Mitchell, 1974; Smith and Cranny, 1968; Neuberger, 1974; Schwab and Cummings, 1970; Vroom, 1964; Wanous and Lawler, 1972; Weinert, 1981; Weir, 1976; Wernimont, 1972).

Many researchers have investigated the relationships between satisfaction and the various elements of organizational settings such as productivity, performance, employee turnover, leadership style, organizational climate, employee identification with the organization, quality of work life, goal setting, and overall individual and organizational well-being. In spite of the many efforts in this area, most research orientations did not report reliable or simple relationships between satisfaction and the particular organizational phenomenon of interest, (with the exception of turnover). For example, Vroom's (1964) analysis of the literature generated correlations between satisfaction and performance ranging from $-.31$ to $+.80$ with a median value of $+.14$.

The reason for the lack of consistent findings may be due to the complexity of this research area. Satisfaction and dissatisfaction seem to be modified by the interaction of a multitude of factors, many of which are only active throughout a partial range of the satisfaction-dissatisfaction dimension. Investigating the interactive effect of these moderator variables, Bhagat (1982) and Ewen (1973) have pointed toward pressure to perform as

a condition which modifies the satisfaction-performance relationship. In addition, it has been recognized that the task performance of individuals and groups is not only affected by various factors in the environment or task demands but also by behavioral and psychological characteristics of individuals. For example, stylistic variables appear to be predictors of important differences in individual and group task performance (e.g., Streufert, 1978; Streufert, Streufert and Denson, 1982).

It has long been recognized that individual differences should be related to satisfaction (e.g., Brayfield and Crockett, 1955; Schaffer, 1953). Nonetheless, the majority of research over the years has focused more frequently on the performance-satisfaction relationship and less on effects of individual differences (e.g., Alderfer, 1969, 1972; and the utilization of Maslow's 1934 theory) or the research efforts directed at the individual (e.g., Downey, Hellriegel and Slocum, 1975; Mehrabian and West, 1977).

More recently, Streufert, Streufert and Pogash (1983) were able to relate two well-established cognitive/perceptual styles, i.e., Type A Coronary Prone Behavior and Cognitive Complexity, to the level of task satisfaction. It was found that more complex persons exceeded their less complex counterparts in satisfaction, and that the satisfaction level of Type B persons was greater than the satisfaction of persons exhibiting Type A behavior.*

In organizational settings such as the military or in industry, individuals are often simultaneously exposed to several sources of potential stress. In a review of the literature on organizational stress, Lester (1983) discusses a number of research efforts concerned with sources of stress which report multiple causes of stress-related symptoms, dissatisfaction, and stress experience. The present research will focus on the effects of multiple stressors on task satisfaction. The degree to which cognitive complexity can predict task satisfaction will be investigated. A visual-motor task environment will be utilized. Both task load and task speed are varied as dual stressor conditions.

Multiple Stressors

Stress researchers have demonstrated considerable interest in the effects of multiple stressors and how these effects differ from effects of stressors

*Type A and cognitive complexity are typically uncorrelated.

acting individually. Effects of multiple simultaneous stressors have been studied over a wide variety of stressor (independent variable) and outcome (dependent variable) conditions. Several research efforts considered the effects of crowding in combination with other stressors. For example, Walden and Forsyth (1981) had subjects perform a task in settings ranging from crowded to uncrowded conditions. In addition, their subjects were either told or not told to expect the occurrence of another secondary stressful event. While measuring the level of cooperation and the speed of walking of urban pedestrians, Boles and Hayward (1978) investigated multiple effects of crowding and noise. Several additional studies have been concerned with the effects of noise in the presence of additional stressors. Bowman and Von Beckh (1979) had subjects perform a tracking task in a multiposition test seat in a human centrifuge during simulated air combat maneuvering. These researchers varied acceleration, vibration/buffet, cockpit noise, cockpit temperature, and seat-back angle. Finkelman (1979) investigated the combined effects of noise with a physical stressor (treadmill run) on both information processing performance and cardiac response. In yet another area of investigation, Bisht (1980) studied the independent and combined effects of school climate and students' need for achievement on academic stress.

In research concerned with work and organizations, Pardine (1981) examined the role of off-the-job stressors on the job stress/work strain relationship. Fazio, Cooper, Dayson and Johnson (1981) compared task performance in Type A individuals (coronary prone behavior style) and Type B individuals under conditions of extraneous task demands. In another comparison of Type A and Type B individuals placed in a task situation, Lovallo and Pishkin (1980) studied the effects of noise exposure and failure, separately and together. The interaction effects of three different role stress variables (role conflict, ambiguity, and overload) with characteristics of job design were examined in research by Abdel-Halim (1981).

Other research evaluated the effects of combined psychological and physical stressors (e.g., Gliner, Bedi and Horvath, 1979). Gliner et. al., manipulated preperformance anxiety and mild exercise to measure hemodynamic changes. In a related effort, changes in blood glucose and blood lipid levels were induced by the presentation of single, multiple or repeated stressor stimuli (Cervinka, Koller & Haider, 1980).

Several research efforts on multiple stressor effects have dealt with the load variable. Of course, load has considerable relevance to organizational decision making. Glass, et. al., (1980) examined load effects of simultaneous tracking and digit recall tasks, combined with high intensity noise, on cardiovascular and plasma catecholamine responses. Variations in speed and load stress on performance in a visual task were investigated by Goldstein and Dorfman (1978). Streufert, Streufert and Gorson (1981) studied the joint effects of load and time urgency upon three measures of information search/information utilization in a complex decision making simulation.

In summary, previous research has utilized a wide variety of stressors, both environmental, psychological and physical and has obtained data on a variety of performance and physiological measures. Even though a wide range of input and output variables were utilized, the vast majority of these research efforts have demonstrated that some kind of interaction among the manipulated stressors is taking place. In other words, most of these studies found that multiple stressors tend to combine in a multiplicative fashion rather than a linear additive fashion to produce detrimental behavioral, physiological, and affective responses.

Cognitive Complexity (Multidimensionality)

Previous research based on complexity theory (e.g., Streufert and Streufert, 1978; Streufert and Swezey, in press) has shown that the more cognitively complex (more multidimensional) person tends to be a better strategist and better planner. However, he or she may not necessarily be as effective when there is a need to respond immediately and decisively (Streufert, Streufert and Denson, 1982). Generally, complex persons consider more dimensions when perceiving their environment. This characteristic may be quite important when a person is judging the impact of challenges on performance expectations. The less complex, i.e., more unidimensional, person tends to be more subject to salience inherent in any task setting: he or she is more likely to focus on the challenge component of a task. He/she is likely to evaluate his/her performance quite differently than a more multidimensional counterpart. A perceived lack of adequate performance, when placed in a challenging task environment, may result in a high level of dissatisfaction. In contrast, the more complex person may be more satisfied under a similar task environment because of his ability to consider his

current levels of (possible inadequate) performance as well as performance in light of the difficulties encountered. This proposition was tested and shown to be accurate by Streufert, Streufert and Pogash (1983) in a visual-motor task. It was found that more complex (more multidimensional) persons were more satisfied with their performance at each level of task difficulty than were less complex (more unidimensional) persons. Furthermore, it was shown that under increasing levels of difficulty, where adequate performance is less and less achievable, the discrepancies between the levels of satisfaction of more complex versus less complex subjects tend to become greater.

These earlier results pointed toward the importance of cognitive complexity as a determinant of task satisfaction. The present research will investigate the effect of cognitive complexity on task satisfaction in a multiple stressor environment.

Task Difficulty Effects on Satisfaction: Load and Speed

Load is a frequently utilized variable in both social and organizational psychology. It has been repeatedly demonstrated that load, as a single stressor variable, has clear effects on performance across a wide variety of task settings (e.g., Bartlett and Green, 1966; Chiles and Alluisi, 1979; Drabeck and Haas, 1969; Jacoby, 1974, 1977; Kelly and Fiske, 1951; Malhorta, Jain and Lagakos, 1982; Miller, 1978; Quastler and Wulf, 1955; Stager and Muter, 1971; Streufert, 1970; Streufert and Streufert, 1982). Furthermore, load relates to task satisfaction (Streufert, Streufert and Pogash, 1983). Task satisfaction appears to be negatively affected by increasing (experienced) load. However, enjoyment of a task, which could, in some cases, be viewed as a specific form of satisfaction, was found to interact independently with stylistic variables. Where challenge is a mediating variable, enjoyment seems to differ quite significantly from satisfaction. Less complex (more unidimensional) persons are apparently more likely to enjoy their task (especially at higher load levels) ~~despite~~ dissatisfaction with their own performance.

Goldstein and Dorfman (1978) explored a manipulation of both speed and load to study the joint effects of speed and load stressors on task performance. The performance of their subjects decreased with increases in either speed or load. Most importantly, however, interaction effects were again obtained. It has not yet been established whether speed and load

stressors are likely to combine to produce interactive effects on satisfaction. The present research effort is concerned with this question.

In the present experiment, load and speed will be manipulated in a visual-motor task which has previously been used to measure both task performance and task satisfaction as a function of varying load levels. Load will be increased from moderate to high challenge levels. Speed will be varied from moderate to fast levels.

METHOD

Sixteen adult males and ten adult females participated as individuals in a series of tasks. Subjects remained in the laboratory for approximately 2½ to 3 hours. The research included a visual-motor task and a sentence completion task (discussed below). Upon arrival at the laboratory, each subject was briefed about the forthcoming events and the subject's signature on a consent form was obtained. The subject was then taken to the laboratory room.

Sentence Completion Task

Each subject was asked to complete the sentence completion test (SCT, in some versions also called paragraph completion test) which was developed by Schroder and Streufert (1963) and Schroder, Driver and Streufert (1967). The subject was handed a package containing ten pages, including an instruction page. Each page contained the stem of a sentence (e.g., when I am criticized...). The subject was asked to finish each sentence and to add several more sentences on the same topic. Approximately two and one-half minutes were to be spent responding to each topic. Topics were specific to various cognitive domains listed by complexity theorists. When the subject had completed one topic, he was to turn the page and go to the next topic and not return to any previous topics he had completed. The sentence completion test assesses the level of subjects' cognitive complexity. Reliability and validity of the test is excellent (c.f., Streufert and Streufert, 1978). The responses of each subject were later scored by one of the developers of the test. Cognitive complexity scores were assigned on the basis of the degree of differentiation and dimensional integration evident in the responses. On the basis of these scores, thirteen subjects were identified as cognitively complex and twelve

were identified as cognitively simple (less complex). One subject was removed from the final analysis because a valid score could not be obtained on the sentence completion task.

Visual-Motor Task

A visual-motor task, previously developed by Streufert and Streufert (1982), was utilized in this research. The task uses the format of a video game, not unlike the familiar Pac-Man. In contrast to other video games, however, the speed of movement and the number of antagonists (stressing load) can be precisely varied in several steps. The game utilizes a series of concentric passageways that are filled with a number of squares which the subject is to "scoop up" with a horseshoe-shaped object that he is able to move by operating a handle on a small box placed on the subject's desk. The matrix of passageways is presented in Figure 1. The subject begins with a score of five points. Scooping up one square adds five points to the score. Moving through one unit of empty space between the squares subtracts one point from the score. In other words, a continuous movement through spaces filled with squares would add $5-1=4$ points for each square collected. Moving through spaces where no squares are present would subtract one point for each empty space, including those spaces previously occupied by squares. In other words, to obtain as high a score as possible, it is useful to avoid moving through blank spaces, i.e., to move so that as many squares as possible can be picked up in one more or less continuous series of moves. Movement is possible only through passageways. Movement across solid lines is not possible.

In addition to the squares, from one to eight dots (differently colored) can appear in the matrix shown in Figure 1. The dots move randomly along the passageways of the matrix, reversing their direction (again randomly) from time to time. The dots are to be avoided: colliding with them is considered an error, costing the subject 100 points for each collision. A collision removes the dot to a different random position in the matrix so that a second collision due to the same error is highly unlikely.

The computer program permits the experimenter to systematically vary a number of characteristics which apply during any one task period. The characteristics which can be modified are: (1) the speed of movement for both the subject's scoop and the dots which the subject is to avoid. Speed

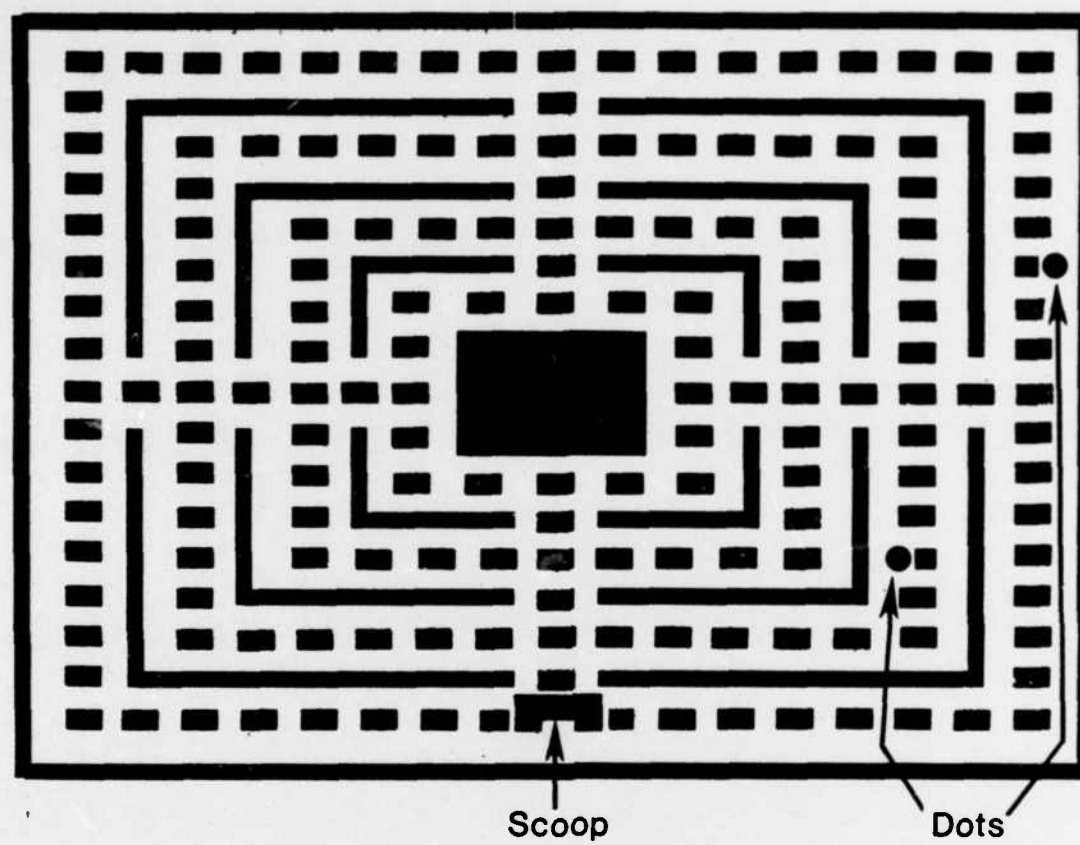


FIG. 1. TASK MATRIX

can be increased or decreased in four equal interval steps; (2) the number of dots on the screen (varying from one to ten); and (3) a constant score (displayed on the screen throughout any task period). The score reflects an experimenter-selected value indicating either the supposed average score obtained by other subjects on their first try or (optionally) the highest score obtained by any subject. In addition, the experimenter is free to select the number of task periods which are to be employed. Each period lasts until the subject has successfully scooped up all the squares from the matrix on the video screen. The subject's current score is continuously and prominently displayed at the bottom of the screen. As stated, the subject's current score starts at +5 and increases as more and more squares are captured. It decreases with collisions with dots and movement through blank spaces. The score may become a negative value if the subject moves through blank spaces 2.5 times more often than through spaces still occupied by squares or if he repeatedly loses blocks of 100 points by collisions with dots.

Instructions to Subjects

Subjects were instructed in detail via video tape about the operation of the task. They were reminded to avoid collisions with white dots. They were also told about the loss of points created by moving through blank spaces. They were further asked to try to do as well as possible, to avoid letting scores drop below zero, and to try hard again during the next task period if they are not as successful as they might wish during any previous period. While the subjects were reminded of the consequences of failing to use strategy, they were not told what strategy should be used to obtain maximal scores. Instructions were moderately challenging, and can be considered somewhat below the challenge and competition level induced by Dembroski, MacDougall, Shields, Petitto and Lushene (1978). The level of challenge and competition selected for these instructions was based on a representation of work environments rather than of experimental environments. Subjects were told to expect different speed levels and different numbers of dots to be avoided from one game period to another. The actual number of periods that would be played was not specified in advance.

Load and Speed Manipulation

Subjects were initially given a practice try to familiarize themselves with the task and to eliminate or decrease the potential effects of previous experiences with video games.* For the practice task, speed was held at level 2 (low). Only one dot was presented in the matrix. After completing this task period (and after all other subsequent periods), subjects responded to a number of seven-point scales (manipulation checks). After completing the scales, the subject was asked whether he was ready to try the task again. All subjects responded positively in all cases.

All subjects participated in six task periods following the practice period. The number of dots, representing the load manipulation,** and the speed at which the dots and scoop were moving throughout the matrix, representing the speed manipulation, was systematically varied for these six periods. Either 2, 5 or 8 dots were placed into the matrix moving at either speed level 2 (moderate speed) or speed level 4 (fast speed). Order of presentation of any load/speed combination was based on random sequences checked via a counterbalancing procedure to assure that specific load and speed level combinations would not occur inordinately often at any sequence position. Subjects were not aware of what their next load and speed level would be until the matrix with the relevant number of dots appeared on their screen at the beginning of the task period.

A read-out at the bottom of the video-screen informed subjects during the first (practice) period that the average score obtained by other subjects during their first try had been 435. That score level was rather easy to achieve. For the following six task periods, the subscript on the screen indicated that the highest score obtained by any subject so far had been 898. None of the subjects achieved or surpassed that score.

*Previous experience with video games, in general, and with Pac-Man specifically, did not affect performance.

**In complex tasks (e.g., Streufert, 1970) load was defined as the number of information (stressor) items per unit time. Load in the present task has a quite similar meaning. While time is held constant, the subject had to attend to the number of antagonistic dots in the matrix, representing levels of loading stressor conditions.

The performance of all subjects in response to tasks at all load levels was video-taped for later analysis. Data were based on performance scores for the six periods following the practice period. Each subject performed the visual-motor task periods before moving to another room to complete the sentence completion task.

Measurement of Satisfaction and Related Concepts

Following each period of the Visual-Motor Task, subjects were asked to respond to a number of seven point scales. The following questions were asked: (1) how difficult did you find the game you just played? (very easy to very difficult), (2) how satisfied are you with your performance for the game you just played? (completely satisfied to not at all satisfied, and (3) how enjoyable was the game you just played? (very enjoyable to not at all enjoyable). The scales were transformed for analysis so that the value of seven indicated very difficult, completely satisfied or very enjoyable. The direction of the scales were alternately inverted for each question to prevent the subject from always choosing one end of the scale without carefully looking over the available choices.

RESULTS AND DISCUSSION

Manipulation Check

The task difficulty scale was analyzed via Analysis of Variance with three factors: Complexity (two levels, between), Speed (two levels, within), and Load (three levels, within). The three factors resulted in significant F ratios: Complexity ($F = 4.99$, 1/23 df, $p = .033$), Speed ($F = 33.05$, 1/23 df, $p < .001$), and Load ($F = 63.874$, 2/46 df, $p < .001$). The data are presented graphically in Figure 2. The more multidimensional subjects rated the task as more difficult at each load level (independent of speed level) than the more unidimensional subjects. Rated difficulty increased significantly with each successive increase in load at both speed 2 (moderate speed) and speed 4 (fast speed). Furthermore, the perceived difficulty was greater for each load level when combined with speed 4 than when combined with speed 2. In addition, a significant interaction effect for speed and load ($F = 3.71$, 2/46 df, $p = .031$) was obtained. A larger discrepancy for perceived difficulty among the speed levels was observed at load level 2 than at load level 5 or 8. The primary finding, however, is the highly significant load

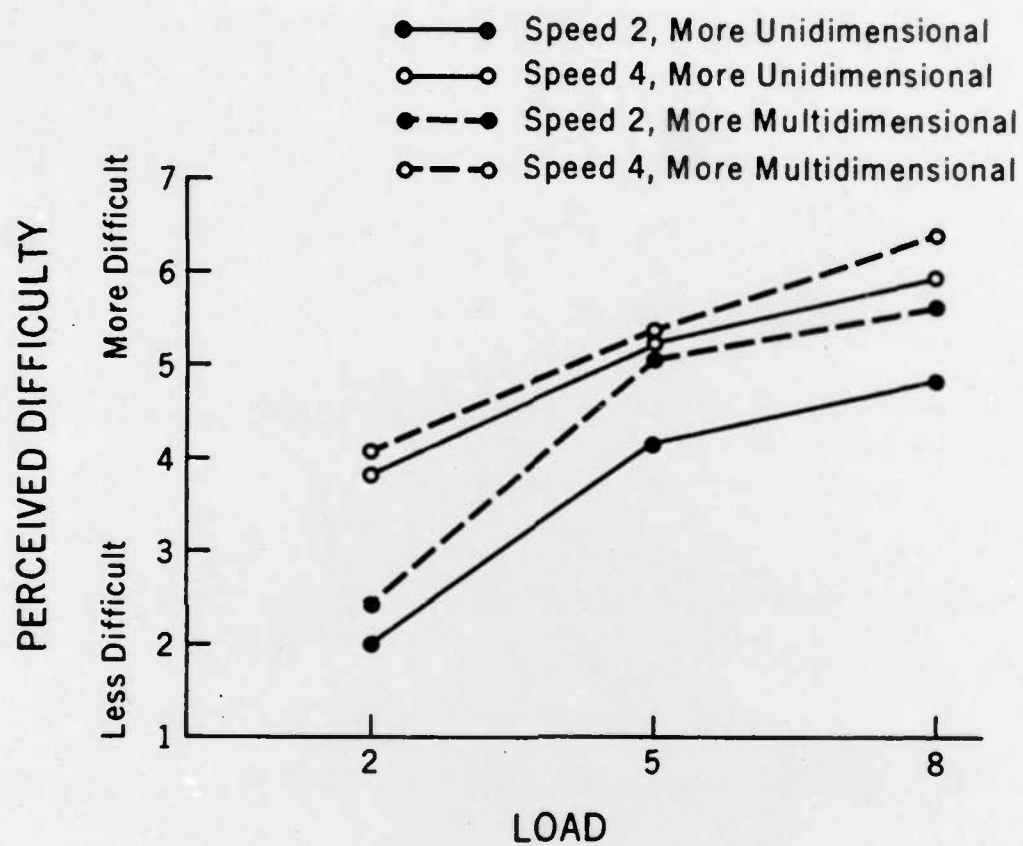


FIG. 2. Effects of load, speed and cognitive complexity on perceived task difficulty

main effect and speed main effect, indicating the effective manipulation of speed and load stressor conditions for this experiment.

Task Satisfaction

Data obtained on the task satisfaction scale were analyzed via a three-way mixed design (1b x 2w x 3w) Analysis of Variance. Main effects for Speed ($F = 6.23$, 1/23 df, $p = .019$) and Load ($F = 21.16$, 2/46 df, $p < .001$) were highly significant. The Complexity main effect did not approach significance ($F = .266$). The data are presented graphically in Figure 3.

A view of figure 3 indicates that satisfaction decreases in significant steps as load increases. A change in the speed level from speed 2 to speed 4 at each load level also has a negative effect on task satisfaction.

Even though Cognitive Complexity did not determine the level of satisfaction, a marginal Complexity by Speed interaction was obtained ($F = 3.23$, 1/23 df, $p = .082$). The less complex (more unidimensional) persons were significantly more satisfied with their performance at the slower speed (speed level 2) than the more complex (more multidimensional) persons. In contrast, at the faster speed level 4, the more complex persons were more satisfied with their performance in the task than the less complex persons.

Increasing the level of speed at each load level did not significantly affect the degree of satisfaction experienced by the more complex individuals. This finding does not apply, however, to the less complex (more unidimensional) persons. At (the optimal) load level 2, a significant Speed effect for these individuals ($F = 8.99$, 1/12 df, $p = .01$) was obtained. More unidimensional persons were more satisfied with their performance at speed level 2 than at speed level 4. This significant discrepancy in experienced satisfaction between speed 2 and speed 4 was not replicated at the higher load conditions.

The present findings do not entirely support previous data reported by Streufert, Streufert, and Pogash (1983). The current findings do, however, support the theoretical view suggesting that increasing task load levels do produce a negative effect on task satisfaction. In addition, this research found that an increase in task speed affects task satisfaction negatively. In contrast to previous findings, however, the stylistic variable, Cognitive Complexity, was only a limited predictor of satisfaction with performance under multiple task stressors. Streufert, et. al., (1983) had obtained considerable success with the complexity variable as a predictor of satisfaction

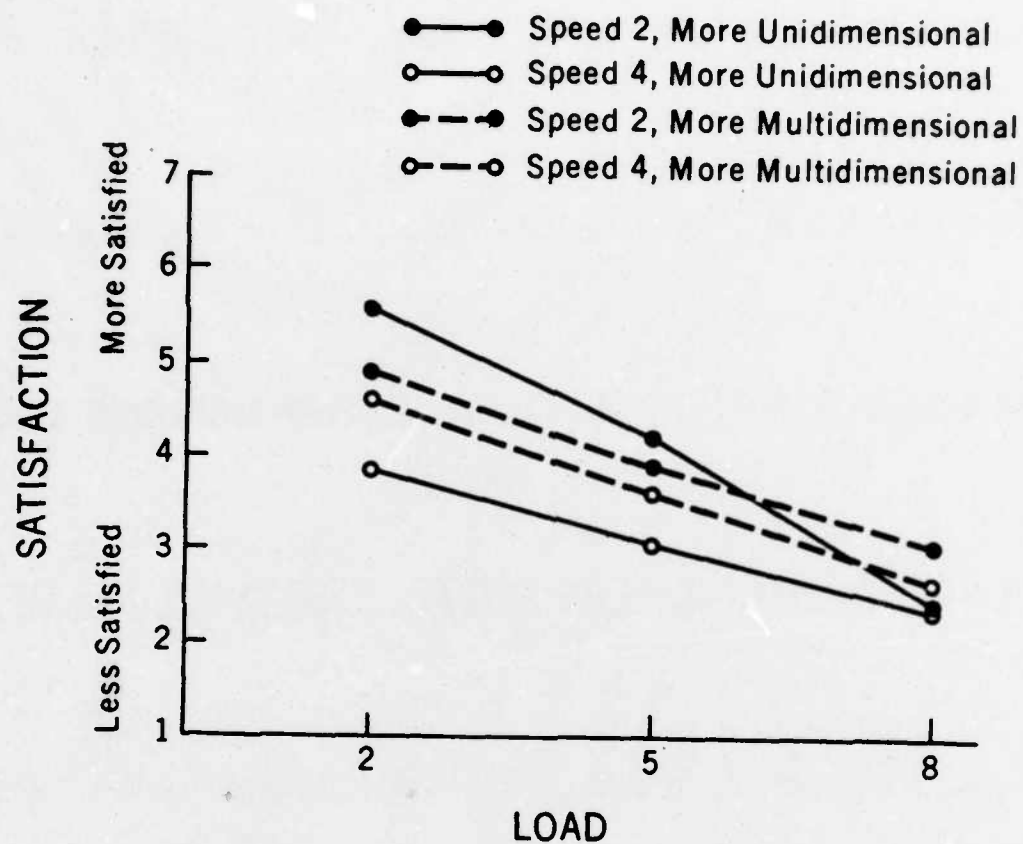


FIG. 3. Effects of load, speed and cognitive complexity on task satisfaction

in single stressor task settings. It appears that the discrepancies between satisfaction levels of more complex and less complex subjects decrease as the task conditions become more challenging. Such effects with increasing stressor impact would be predicted on the basis of complexity theory (c.f., Streufert and Streufert, 1978).

As predicted, the addition of a second stressor, task speed, did not significantly alter the level of satisfaction experienced by the more complex individuals. However, at (the optimal) load level 2, the less complex subjects perceived themselves as less able to successfully perform the task under a more challenging condition, increased speed, resulting in decreased satisfaction. These findings appear to suggest that multiple stressor interaction effects on satisfaction may only be obtained for less multidimensional persons.

Task Enjoyment

Data analysis for task enjoyment (utilizing the same ANOVA design discussed earlier) produced a significant main effect for Load ($F = 3.83$, 2/46 df, $P = .028$) and a marginal effect for Speed ($F = 3.51$, 1/23 df, $p = .07$). Again the F ratio for the Complexity main effect failed to approach significance ($F = .11$). The data are graphically represented in Figure 4. The level of enjoyment decreased with increasing load but increased marginally with increasing speed. Furthermore, both the more complex (more multidimensional) persons and the less complex (more unidimensional) persons equally enjoyed the visual-motor task at each difficulty level.

Analysis comparing satisfaction and enjoyment levels produced a significant difference between satisfaction and enjoyment ($F = 13.23$, 1/23 df, $p < .001$). This strongly suggests that enjoyment and satisfaction are indeed two distinct phenomena. Further investigation into the discrepancies between the levels of task enjoyment and task satisfaction among persons with differing cognitive complexities may reveal some interesting motivational differences.

In summary, increasing the levels of either task load or task speed appears to produce a detrimental effect on the perceived satisfaction of one's own performance. Under these multiple stressor conditions, however, the stylistic variable, Cognitive Complexity, appears to be less helpful in determining the particular levels of satisfaction one may experience. The diminished effect of individual differences in cognitive complexity is likely due to the theoretically predicted similarity in responses under

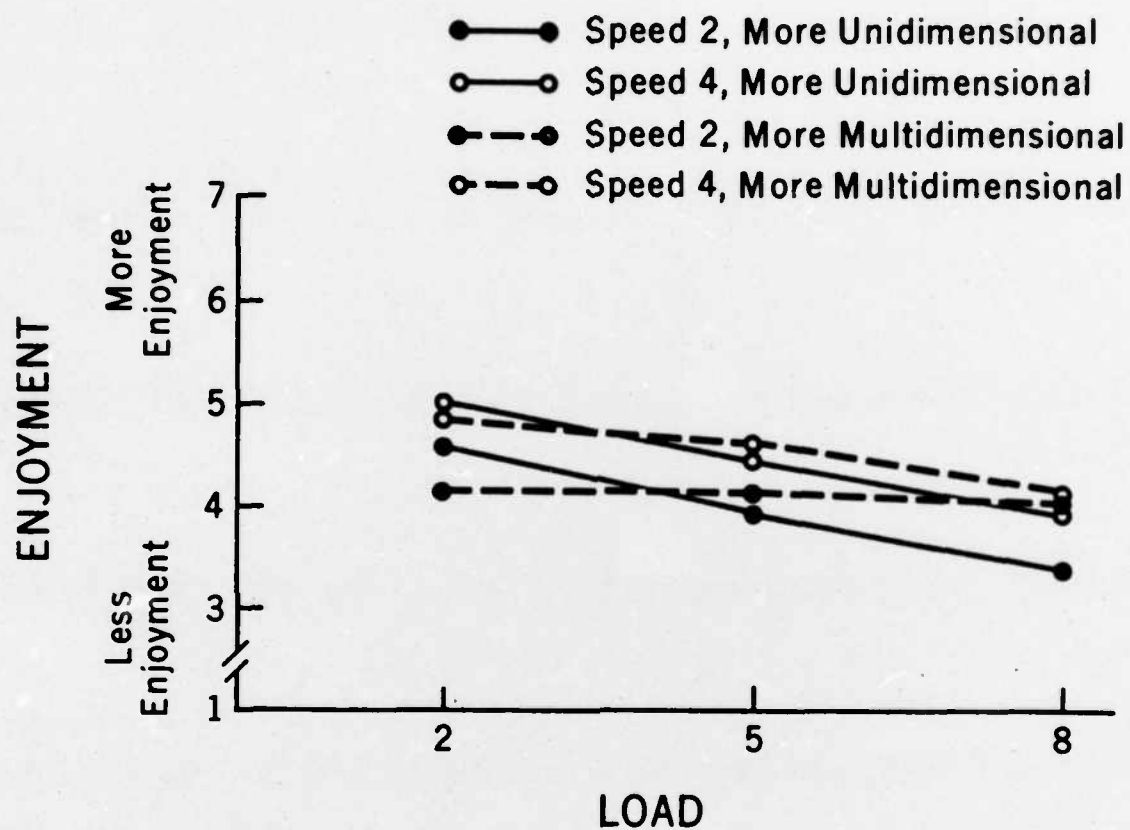


FIG. 4. Effects of load, speed and cognitive complexity on enjoyment

excessive stressor experience. Differences could only be expected when the primary or the secondary stressor level remains low. Indeed, an interesting interaction between complexity and speed was obtained at (the optimal) load level of 2 which was not replicated at higher load levels. In addition, it was found that the level of perceived task enjoyment may not be a determinant of the level of satisfaction with one's performance. Rather, it appears that enjoyment and satisfaction represent two quite different cognitions. Finally, measurable multiplicative effects arising from the interaction of load and speed may only be demonstrated at more optimal load conditions and only for more unidimensional persons.

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